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ART 34 AMU

Claims:

1. A composite polymer electrolyte composition comprising a polymerization product of a monomer composition comprising (a) a molten salt monomer having a polymerizable functional group and a quaternary ammonium salt structure consisting of a quaternary ammonium cation and a fluorine-containing anion, and (b) a electrochemically inert polymer reinforcing material present in said monomer composition together with said monomer (a).

2. The composite polymer electrode composition of claim 1 wherein said monomer composition further comprising a polyfunctional monomer copolymerizable with said molten salt monomer.

3. The composition of claim 1 wherein said quaternary ammonium cation is selected from the group consisting of 1-vinyl-3-alkylimidazolium cation, 4-vinyl-1-alkylpyridinium cation, 1-alkyl-3-allylimidazolium cation, 1-(4-vinylbenzyl)-3-alkylimidazolium cation, 1-(vinylloxyethyl)-3-alkylimidazolium cation, N-vinylimidazolium cation, 1-allylimidazolium cation, N-allylbenzimidazolium cation and quaternary diallyldialkylammonium cation, and wherein said fluorine-containing anion is selected from the group

consisting of bis[(trifluoromethyl)sulfonyl]imide anion, 2,2,2-trifluoro-N-(trifluoromethylsulfonyl) acetamide anion, bis[(pentafluoroethyl)sulfonyl]imide anion, bis(fluorosulfonyl)imide anion, tetrafluoroborate anion and trifluoromethanesulfonate anion.

4. The composite polymer electrolyte composition of claim 1 wherein said polymer reinforcing material is selected from the group consisting of polytetrafluoroethylene, polyvinylidene fluoride, polyethylene, polypropylene, polyacrylonitrile, polystyrene, polysulfone, polyether sulfone, polyetherketone, polyether ether ketone, polyetherimide, polyamideimide and polyimide.

5. The composite polymer electrolyte composition of claim 1 wherein said polymer reinforcing material is polyvinylidene fluoride or a modified polyvinylidene fluoride containing a plurality of carbon-to-carbon double bonds.

6. The composite polymer electrolyte composition of claim 1 wherein said polymer reinforcing material forms a polymer blend with the polymer of said molten salt monomer.

7. The composite polymer electrolyte composition of claim 1 wherein said polymer reinforcing material is a porous sheet or film containing a large number of

continuous pores, and wherein the polymer of said molten salt monomer forms a continuous phase through said pores.

8. The composite polymer electrolyte composition of claim 1 wherein said monomer composition is polymerized by heat.

9. The composite polymer electrolyte composition of claim 1 wherein said monomer composition is polymerized by irradiating with UV radiation.

10. The composite polymer electrolyte composition of claim 1 wherein said monomer composition is polymerized by irradiating with electron beam.

11. The composite polymer electrolyte composition of claim 1 wherein said monomer composition further comprises a charge transfer ion source.

12. The composite polymer electrolyte composition of claim 1 wherein said charge transfer ion source is selected from the group consisting of  $\text{LiBF}_4$ ,  $\text{LiPF}_6$ ,  $\text{C}_n\text{F}_{2n+1}\text{CO}_2\text{Li}$ ,  $\text{C}_n\text{F}_{2n+1}\text{SO}_3\text{Li}$ ,  $(\text{FSO}_2)_2\text{NLi}$ ,  $(\text{CF}_3\text{SO}_2)_2\text{NLi}$ ,  $(\text{C}_2\text{F}_5\text{SO}_2)_2\text{NLi}$ ,  $(\text{CF}_3\text{SO}_3)_3\text{CLi}$ ,  $(\text{CF}_3\text{SO}_2\text{-N-COCF}_3)\text{Li}$  and  $(\text{RSO}_2\text{-N-SO}_2\text{CF}_3)\text{Li}$ , wherein  $n$  is an integer of 1-4 and  $R$  is an alkyl or aryl group.

13. A lithium ion battery comprising the

composite polymer electrolyte composition of claim 12 sandwiched between an anode and a cathode.

14. The composite polymer electrode composition of claim 12 wherein said charge transfer ion source is selected from the group consisting of  $\text{HBF}_4$ ,  $\text{HPF}_6$ ,  $\text{C}_n\text{F}_{2n+1}\text{CO}_2\text{H}$ ,  $\text{C}_n\text{F}_{2n+1}\text{SO}_3\text{H}$ ,  $(\text{FSO}_2)\text{NH}$ ,  $(\text{CF}_3\text{SO}_2)\text{NH}$ ,  $(\text{C}_2\text{F}_5\text{SO}_2)\text{NH}$ ,  $(\text{CF}_3\text{SO}_2)_3\text{CH}$ ,  $\text{CF}_3\text{SO}_2\text{-NH-COCF}_3$ , and  $\text{RSO}_2\text{-NH-SO}_2\text{CF}_3$ , wherein  $n$  is an integer of 1-4 and  $R$  is an alkyl or aryl group.

15. A fuel cell comprising the composite polymer electrode composition of claim 14 sandwiched between the opposing pair of an anode and a cathode.

16. The composite polymer electrode composition of claim 11 wherein said charge transfer ion source is  $\text{I}_3/\text{I}^-$  or  $\text{Br}_3/\text{Br}^-$  redox ion pair.

17. A dye sensitized solar cell comprising the composite polymer electrolyte composition of claim 16 sandwiched between a sensitising-dye-adsorbed oxide semiconductor film and an electroconductive counter electrode.

18. An electrolytic capacitor comprising a composite polymer electrolyte composition of claim 1 free from a charge transfer ion source sandwiched between an opposing pair of electroconductive electrodes.